USEJ 6 (3) (2017)

Unnes Science Education Journal

http://journal.unnes.ac.id/sju/index.php/usej

DEVELOPING THE UNDERSTANDING OF SCIENTIFIC CONCEPT BASED ON THE ASPECT OF SCIENCE LITERACY FOR STUDENTS OF ELEMENTARY SCHOOL EDUCATION PROGRAM THROUGH THE APPLICATION OF PROJECT BASED LEARNING

Siti Masfuah✉ and Fina Fakhriyah

Elementary School Education Program,
Teaching and Education Faculty
Universitas Muria Kudus, Indonesia

Article Info

Received July 2017
Accepted October 2017
Published December 2017

Keywords:
Conceptual Understanding, Scientific Concept, Science Literacy, Project Based Learning

Abstract

This research aims to: 1) know the better learning model in developing science concept comprehension in science application course, that is learning model of project based learning or direct learning in ELEMENTARY SCHOOL EDUCATION PROGRAM student of 3rd semester on Science Application course and 2) to know the influence of student skill In making the media towards understanding the concept of science. This study uses quasi experimental design. The population of this research is 3 semester students of ELEMENTARY SCHOOL EDUCATION PROGRAM UMK with 3H class sample as experiment class and class of 3G as control class determined by random sampling. In the beginning, both classes were given pretest, then the PjBL learning treatment in the experimental class and direct learning in the control class. At the end of the meeting, the two classes are given postes for analyzed improvement and hypothesis testing. Hypothesis test is done by data analysis using inferential statistic that starts from homogeneity test, normality test, gain test, t test and simple linear regression test. Based on the data analysis, it is known that the average value of the conceptual understanding of the experimental class is better than the control class. In addition, based on gain test it is known that the improvement of understanding of experimental class concept is 0,49 (medium), while control class increase equal to 0,29 (low). Furthermore, based on the regression test, the equation obtained $\hat{Y} = 1.047 X - 4,36$ and obtained the correlation coefficient between the skill of making the media with student concept understanding (rXY) of 0.42 which means there is a positive relationship between the skill of making the media with the understanding of student concept. In addition, based on data analysis, obtained coefficient of determination (r2) of 0.18 which means that 18% understanding of concepts influenced by the skill of making media, while 82% influenced by other factors.

p-ISSN 2252-6617
e-ISSN 252-6232

✉Corresponding Author:
S. Masfuah
Science Education Program, Faculty of Mathematics and Natural Science Universitas Negeri Semarang
D7 Building, Gunungpati Sekaran Campus
Telp. (024) 70805795 Postcode 50229
E-mail: siti.masfuah@umk.ac.id

INTRODUCTION

Quality educators are the key of nations' civilization. A professional and high-quality teacher can shape the future generation with good competence and competitiveness. Besides, entering the era of ASEAN Economic Community (AEC) makes the development of science education is very influenced by the development of science and technology which is taught formally at school. The challenge of higher education especially educational institution in preparing quality and competitive teacher is getting higher. One of the efforts can be done through developing learning model for the students which develops students' hardskills and softskills. Science literacy skills can represent the hardskills and softskills of the students. Since, science literacy is the ability to understand science along with its application in daily life. This literacy copes the ability of students in solving problems based on scientific skills.

Based on the data of PISA OECD (Programe for International Student Assessment-Oganisation for Economic Cooperation and Development) in 2015, there were measurement regarding science literacy among countries. Indonesia was still placed on lower area in which 56% students were in the level 1, 31.7% were on level 2, 10.6% on level 3, 1.6% on level 4, 0.1% on level 5 (OECD, 2016). It showed that Indonesian students' achievement on science was still low, eventhough there was an improvement of the score from PISA in 2012. This problem was caused by the learning of science which was not directed to the development of science literacy. However, science literacy was not understood perfectly by teachers. In terms of content, the learning process of science still emphasized on the memorization, thereby, the students did not understand what they learn; they only know it in glance instead (Jufri, 2013).

Ideally, teachers of science should teach science comprehensively. Science consists of some components: products, process, application, and scientific behavior. Somehow, science learning only teaches science as a product instead of including the process, application, and scientific behavior. By acknowledging scientific process, college students can obtain, develop, and apply the knowledge of procedures, mindset, problem-solving, and behavior of science.

Based on the previous research by Fakhriyah, *et al* (2017), science literacy level of Elementary School Education program in UMK were 66.2% students were in nominal level and 33.8% students were in functional level. Based on the data, students already have the concept to relate science with other discipline. They are able to write scientific terms despite having misconception. Meanwhile, 33.8% students understand theory and able to explain the concept correctly. Nonetheless, they have limited understanding in connecting concepts to their own opinions. In Wena (2014), some of the students opine that scientific concepts is very difficult. The understanding of scientific concept is an important step for students to construct their understanding deeper. Understanding scientific concept is a process where students suppose to understand concept, situation, and facts to solve problems in their environment. Therefore, teachers will be considered success in scientific process if they are able to change learning process which is initially less interesting, difficult, and meaningless to be very interesting, very difficult, and meaningful. In the end, students will see science as their needs, not as a force to them.

To upgrade the result of science literacy's measurement in the aspect of content as well as to prepare future elementary school teacher which have good competence and skills, there should be a learning model which invites them to actively find concept, understand scientific concept, and build concept based on some experiences which were obtained from the data in the surrounding environment. By using Project based learning (PjBL), it is hoped to help students in improving science literacy of the students as well as handling misconception.

Project based learning is a learning process focusing on the development of product or performance, where students do, review, or organizing activities, research, and

study in groups. It also trains students to solve problem and synthesize information. The project in the learning process is done in certain period with certain steps starting from preparation, deciding projects, planning, investigation, making reports, communicating the result of the research, and evaluation. Using PjBL, students will develop their potentials, critical thinking, and creativity. Thus, students will be actively involved in the learning process and making the learning process meaningfull with measured science understanding and optimum. It is supported by Santyasa (2008) that PjBL can improve students' confidence, motivation to learn, creativity, and self-esteem.

Wena (2014) opines that the focus of learning process in project based learning is involving students in activities of solving problems and other meaningful tasks. It opens the chances of students to work autonomously and construct the way they learn. It makes them able to produce something. Students can also directly develop their scientific understanding. By developing their understanding of scientific concept, students are hoped to be able to improve science literacy through project based learning.

This research aimed to 1) unveil the best learning model to develop the understanding of scientific concept in science application subject, where the learning model of project based learning or direct learning of Elementary School Education Program in Semester 3 and 2) to unveil the influence of the students' skills in making the learning media of the science application subject.

METHODS

This research was initiaed with previous studies which obtained the literacy of Elementary School Education Program of UMK were 66.2% students were in nominal level and 33.8% students were in functional level. (Fakhriyah *et al*, 2017). Hayati (2017) states that nominal level emphasizes on memorization. Thus, there should be further research of learnig model which can develop college students' ability to think.

Science literacy ability can be developed in 5 categories: 1) illiteracy. In this level, students do not only connect or respond a logical question of science. They do not have the vocabulary, concept, context, or cognitive ability to identify scienfic question; 2) nominal level. In this level, students have the concept to connect science and write scientific terms with misconception on their understanding. 3) functional level. In this level, students can develop the main concept correctly. Nevertheless, students cannot draw connection between concepts or having limited understanding. Students can remember theories or facts, but they cannot state their opinion. 4) conceptual level. In this level, students develop their knowledge to connect different disciplines to science. Students can also understand a problem, validate an answer, and analyze the alternatives of answers. Besides, students can use their concept to explain scientific phenomena. 5) multidimensional level. Students have the comprehensive understanding of science and able to connect and relate interdisciplinary explanation as well as own a scientific investigation's procedures. It copes the philosophical, historical and social dimension of science and technology. Students can relate sciences, technology, and issues in the society.

After obtaining the measurement of science literacy lebel, the researcher planned a research to improve students' science literacy by using PjBL.

This research is a descriptive quantitative research quasi-experimental design. This research objected to describe the application of project based learning to develop the understanding of science concept based on the content of science literacy for college students and to unveil whether the understanding of science concept based on the content of science literacy for college students is better after the application of project based learning to the 3rd semester students in elementary school education program in Universitas Muria Kudus (UMK) focusing on Science Application subject. The population of this research was 3rd semester students of Elementary School Education program of UMK in the academic

year 2016/2017 with 3G class as the control class and 3H class as the experimental class. The class was taken using random sampling method since there was no any emercy class.

The variables of this research were the understanding of scientific concept from the content of science literacy under the indicators of: 1) restating a concept, 2) grouping objects based on certain characteristics, 3) providing example and non-example of certain concepts, 4) delivering concepts in different mathematic forms, 5) developing required condition of a concepts, 6) using, utilizing, and choosing certain concepts, and 7) applying certain solution to problems (Yusuf, 2003). The variable of the research was measured using test which is related to the aspects of science literacy's contents.

The instruments were analyzed with descriptive statistics analysis to measure the validity, reliability, difficulty, and item discrimination of the exercises. Then, it was assessed with inferential statistics to know whether the scientific concept based on science literacy is better to be applied using project based learning or direct learning to 3rd semester elementary school education program in science application subject. It was then assessed with simple linear regression using coefficient correlation and coefficient determination to know how far is the influence of students' skills in making a project of science learning media to students' concept. The project of the media should be made by the students were science comic, students' worksheet, learning materials CD, herbarium, and properties for physics and biology. The media was assessed for students' performance assessment.

The proposed hypotheses in this research were:

Ho_1 : the average score of the understanding to science concept in the experiment class is lower or the same to the control class

Ha_1 : the average score of the understanding to science concept in the experiment class is higher or the same to the control class

Ho_2 : there is no any significant influence between skills of making media (X) to students' understanding of concepts (Y)

Ha_2 : there is a significant influence between skills of making media (X) to students' understanding of concepts (Y).

RESULTS AND DISCUSSION

This research is the follow up from the previous research. The researcher began this research by using the learning tools starting from syllabus, learning plan, students' activities sheets, working instruments, and testing instruments. Before the instruments were used, all the tools were validated by experts to obtain valid tools. Based on the validation assessment from 2 experts, the score of the categories were very valid (88.5). After that, the instruments of the test were tested in small scale in 20% portion from the sample of the researches which were 19 students in 5th semester to know the validity, reliability, and item discrimination.

After the analysis, the researcher took two classes as the samples of the research, which were 3G and 3H. The samples were chosen based on homogeneity test. The researcher assessed the homogeneity used F-test to ensure that both of the class came from the same or different ability. Based on the analysis of the data, F-score was counted as 1.73, meanwhile, the F-score was 3.21. Thus, two classes had the same level of intelligence. Then, the researcher determined the samples of the tests with random sampling to decide tha 3H as the experiment class (class with project based learning) and 3G as the control class (direct lecture). Before the treatment, both classes were given pretest. Experiment class were given project based learning with the project of making science learning media, while control class was given direct learning afterwards. Next, all classes were given posttest, hypothesis test, and simple linear regression test to know their improvement. Before the hypothesis, the the normality of posttest scores were measured with chi-square (X^2). The measurement can be seen in Table 1.

Table 1. The Normality of Posttest Score

Variation	Experiment Class	Control Class
X^2_{count}	24.02	14.46
X^2_{table}	11.07	12.59
Criteria	Normally distributed	Normally distributed

After obtaining the posttest score, both classes were measured to see how significant the improvement was. The description of gain test can be seen in Table 2.

Table 2. Gain Test

Variation	Experiment Class	Control Class
Average Pretest Score	63	69
Average Posttest Score	81	78
Gain Score	0.49	0.29
Criteria	Medium	Low

After that, the posttests were measured with t-test and simple linear regression test. Based on table 1, it is known that both classes had normal and homogenous distribution. Thus, the hypothesis test and t-test right side were done with the score of 2.39 and t table of 1.99. The description of the data can be seen in Table 3.

Table 3. Description of Data in the Right Side

Variation	Experiment Class	Control Class
Highest Score	85.80	85.20
Lowest Score	60.44	56.78
Total (n)	46	50
Mean	81.30	78.39
Variance (s^2)	13.92	33.86
Standard of Deviation (s)	3.37	5.82
t count	2.39	Criteria: average score of students' understanding in the experiment class was better than the control class
t table	1.99	

Based on Table 3, the average understanding of students in the experiment class was better than the control class. Besides, in the gain Table 2, the improvement of understanding from experiment class students was better than the control class. These t-test and gain test results were caused by the treatment to experiment class. Experiment class obtained science application learning model with project based learning, while the control class obtained direct lecture.

PjBL is a learning model which focused on the concept and involved students to be active in the problem-solving activity to produce a real product (Wena, 2014). Before the students made the media, they understood the concept, analysis, and problem solving. They created new media which can be used by elementary schools students to discover scientific concepts which is close to students' daily life (contextual). Fauziah (2010) states that the implementation of contextual approach in learning can increase students' conceptual understanding. Besides, context, practice, and direct demonstration was a correct media for learning process, since it includes the visualization of abstract concept (Susilaningsih, *et al.*, 2016). The media should

be made in different form than the media in the laboratory. They should also be based on inquiry. Sastrika, *et al* (2013) states that project based learning can imrove students conceptual understanding and critical thinking ability. PjBL is also proven effective to students' psychomotoric skills (Muktisari, *et al.*, 2016). Besides, Rakhmawan *et al* (2015) mentions that inquiry based learning can increase students' science literacy level. Thus, if students' understanding is improved, their literacy will be increased. It supports Lindawati *et al* (2013) that PjBL can improve students' cognitive, affective, and psychomotoric ability.

After knowing the average score of experiment students was better than the control class, a simple linear regression test was done. The analysis obtained the equation of $\hat{Y}$ =1.047 X – 4.36. The data can be seen in Table 4.

Tabel 4. Regression Test to the Ability of Producing Properties to Understand Concept

Regression Test	Science Literacy
Regression Equation	$\hat{Y}$ = 1.047 X – 4.36
Meaning and Linearity of Regression's Equation	F count = 9.86 F table = 4.06 Criteria = Significant
Coefficicent Correlation (r_{xy}) and determination (r^2)	r_{xy}= 0.42 r^2 = 0.18
The test of coefficient correlation meaning	t count = 3.10 t table = 2.02 Criteria= Significant

Based on Table 4, the data was shown X = 0 (the skills of making product was absent), thus, it obtained the score $\hat{Y}$ of -4.36. It shows that $\hat{Y}$ is not only influenced by skills to create product which is related to concept, but there were other influencing factors, such as motivation, interest, class environment, educational background, and personal skills. Agustina & Debi (2015) state that one factor which positively influence students' understanding is educational background. Fakhriyah *et al* (2017) states that 66.2% students were in nominal level and 33.8% students were in functional level. The low score were originated from Elementary School Education Program students' heterogenous educational background. Besides, Masfuah (2015) states that the influencing factors to students' literacy was their personal conceptual understanding. Understanding of science concepts promotes students' science literacy (Allchin, 2014). It means if their understanding of concept is good, their science literacy is also good.

After obtaining the equation of linear regression, the researcher discovered the meaning of simple linear regression to know how significant is the ability to create media of conceptual application to students' conceptual understanding. Table 4 shows that $\hat{Y}$ =1.047 X – 4.36. The positive sign in coefficient 1.047 X shows that skills to create media is positively influential to students' conceptual understanding. It was due to project based learning which involved students in discovering problems, deciding the core of problems, and solving the problems by producing the correct media based on the concept. Beside making the product, PjBL was initiated by inquiring concepts and problem solving. Dwi, *et al* (2013) conducted research and obtained that the strategy of problem based learning can improve students conceptual understanding. Then, tasks of making media was done individually and in groups. In group activities, students will have active communication and sharing of ideas

between group members. Later, it obtained clear media concept which made them understand the concept deeper. Purwati (2014) states that cooperative learning can improve students' understanding.

Besides, experiment class got project to make many media, like science comic, students' worksheet, learning materials CD, herbarium, and properties for physics and biology. These tasks demanded deep understanding of students regarding the materials. Suhandi & Wibowo (2012) did a study regarding the effectiveness of multipresentation approach which involves factorial, mathematic, graphic, and animation representation which is then implemented in students' media. In the other hand, online assessment and ICT test can improve the effectiveness of project based learning (Ravitz & Juliane, 2014).

The next step was counting the coefficient correlation (r_{xy}) and coefficient determination (r^2). Based on Table 4, the value of coefficient correlation was 0.42. this positive score showed that there was a positive relation between the ability of creating media and students' conceptual understanding. In other cases, coefficient determination of 0.18 or 18%, showing that 18% students conceptual understanding were caused by their ability in creating media, leaving 82% for other factors. This result is in line to Ulfah *et al* (2016) which did research and showed that conceptual understanding was influenced by students, teachers, and the environment. Kusuma & Subkhan (2015) state that discipline and learning motivation influence students conceptual understanding and learning outcome.

CONCLUSION

Based on the analysis, it can be concluded that PjBL is more effective to improve students' conceptual understanding than direct lecture. It was supportd with gain test from the improvement of pretest and posttes score between experiment and control class. In this case, the improvement of the experiment class was 0.49 in medium category, and the control class was in 0.29 or low. In linear regression test, there was a significant influence of PjBL by creating many science learning media for performance assessment (X) to students' conceptual understanding (Y). It showed that the higher the skills in making media, the higher the conceptual understanding of the students. It was strengthened by a coefficient of correlation in 0.42 (medium) and coefficient determination of 18%. It shows that 18% students conceptual understanding were caused by their ability in creating media, leaving 82% for other factors.

The proposed suggestions from the researcher was the scheme of students exercise to make media should be given as an individual task. Thus, the portrayal of students' conceptual understanding will be more valid. Besides, for the performance assessment, the products should be validated by experts instead of college students. Thus, to gain the validity, the instrument should not only in written test, but also performance test and students activities sheets.

REFERENCES

Agustina & Debi, M., Y. (2017). Analisis Faktor-Faktor yang Mempengaruhi Tingkat Pemahaman Akuntansi Mahasiswa Jurusan AKuntansi STIE Mikrosikil Medan. *Jurnal Wira Ekonomi Mikroskil*, 5(1): 11-20.

Agustina & Debi, M.Y. (2017). Analisis Faktor-Faktor yang Mempengaruhi Tingkat Pemahaman Akuntansi Mahasiswa Jurusan AKuntansi STIE Mikrosikil Medan. *Jurnal Wira Ekonomi Mikroskil*, 5(1): 11-20.

Allchin, D. (2014). From Science to Scientific Literacy: A View from the Classroom. *Science & Education*, 23(9): 1911-1932.

Dwi, I. M., Arif, K. & Sentot, K. (2013). Pengaruh Strategi *Problem Based Learning* Berbasis ICT terhadap Pemahaman Konsep and Kemampuan Pemecahan Masalah Fisika. *Jurnal Pendidikan Fisika Indonesia*, 9(1): 8-17.

Fakhriyah, F., Masfuah, S., Roysa, M., Rusilowati, A., Rahayu, E. S., et. al. (2017). Student's Science Literacy in The Aspect of Content Science?. *Jurnal Pendidikan IPA Indonesia*, 6(1): 81-87.

Fauziah, A. (2010). Peningkatan Kemampuan Pemahaman and Pemecahan Masalah Matematik Siswa SMP melalui Strategi REACT. *Forum Kependidikan*, 30(1): 1-13.

Hayati, M. N. (2017). The Use of Science Literacy Taxonomy to Measure Chemistry Literacy of the Science Teacher Candidates. Unnes Science Education Journal, 6(1): 1486-1492.

Jufri, W. (2013). *Belajar and Pembelajaran Sains*. Bandung: Pustaka Reka Cipta.

Kusuma, L. (2015). Pengaruh Motivasi Belajar and Kedisiplinan Terhadap Prestasi Belajar Mata Pelajaran Akuntansi Siswa Kelas XI IPS SMA N 3 Pati Tahun Pelajaran 2013/2014. *Economic Education Analysis Journal*, 4(1): 164-171.

Kusuma, Z. L., & Subkhan. (2015). Pengaruh Motivasi Belajar and Kedisiplinan Belajar Terhadap Prestasi Belajar Mata Pelajaran Akuntansi Siswa Kelas XI IPS SMA N 3 Pati Tahun Pelajaran 2013/2014. *Economic Education Analysis Journal*, 4(1): 164-171.

Lindawati, Siska, D. F., & Arif, M. (2013). Penerapan Model Pembelajaran *Project Based Learning* untuk Meningkatkan Kretaivitas Siswa MAN 1 Kebumen. *Jurnal Radiasi*, 3(1): 42-45.

Masfuah, S. (2015). Pengaruh Kecakapan Personal Terhadap Literasi Sains. *Jurnal Refleksi Edukatika*, 6(1): 24-29.

Muktisari, E., Margareta, R. & Andin. I. (2016). Efektivitas Model Pembelajaran *Project Based Learning* dengan Media Fotonovela Keanekaragaman Hayati Terhadap Kemampuan Psikomotorik Siswa. *Unnes Science Education Journal (USEJ)*, 5(3): 1440-1443.

OECD. 2016. *PISA 2015 Result Excellence and Equity in Education (Volume 1).* Paris: OECD Publishing, from https://www.mecd.gob.es/inee/dam/jcr:54fd088e-f421-49c7-8ee2-852aff57682f/pisa2015-results-eng-vol1.pdf

Purwati. (2014). Meningkatkan Hasil Pemahaman Siswa melalui Model *Cooperatif Learning* Tipe Jigsaw pada Pembelajaran IPS di Kelas IV SDN No. 1 Bonemarawa Kecamatan Rio Pakava Kabupaten Donggala. *Jurnal Kreatif Tadulako*, 3(4): 174-184.

Rakhmawan, A., Agus, S. & Ahmad, M. (2015). Perancangan Pembelajaran Literasi Sains Berbasis Inkuiri Pada Kegiatan Laboratorium. *Jurnal Penelitian and Pembelajaran IPA*, 1(1): 145-154.

Ravitz, J & Juliane, B. (2014). Assessing the Role og Online Technologies in Project Based Learning. *Interdisciplinary Journal of Problem Based Learning*, 8(1): 65-79.

Ravitz, J., & Blazevski, J. (2014). Assessing the Role of Online Technologies in Project-based Learning. *Interdisciplinary Journal of Problem-Based Learning*, 8(1): 65-79, from http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1410&context=ijpbl

Santyasa, I W. & Suwindra, I N. P. (2008). Pengembangan Pemahaman Konsep and Kemampuan Pemecahan Masalah Fisika Bagi Siswa SMA Dengan Pemberdayaan Model Perubahan Konseptual. *Laporan hasil penelitian*. Universitas Pendidikan Ganesha.

Sastrika, I. A. K., I Wayan, S. & I Wayan, M. (2013). Pengaruh Model Pembelajaran Berbasis Proyek terhadap Pemahaman Konsep Kimia and Keterampilan Berpikir Kritis. *Jurnal Mimbar Elementary School Education Program Universitas Pendidikan Ganesha*, 3(1): 147-159, from

Suhandi, A. & Wibowo, F. C. (2012). Pendekatan Multipresentasi dalam Pembelajaran Usaha-Energi and Dampak Terhadap Pemahaman Konsep Mahasiswa. *Jurnal Pendidikan Fisika Indonesia*, 8(1): 1-7.

Susilaningsih, E., Kasmui & Harjito. (2016). Desain Instrumen Tes Diagnostik Pendeteksi Miskonsepsi untuk Analisis Pemahaman Konsep Kimia Mahasiswa

Calon Guru. *Unnes Science Education Journal (USEJ)*, 5(3): 1427-1431.

Ulfah, T., Rusman & Ibnu, K. (2016). Analisa Kesulitan Pemahaman Konsep Kelarutan and Hasil Kali Kelarutan Pada Siswa SMA Inshafuddin Tahun Ajaran 2015/2016. *Jurnal Ilmiah Mahasiswa Pendidikan Kimia*, 1(4): 43-51.

Wena, M. (2014). *Strategi Pembelajaran Inovatif Kontemporer Suatu Tinjauan Konseptual Operasional*. Jakarta Timur: PT Bumi Aksara.

Yusuf, Munawir. (2003). *Pendidikan Bagi Anak dengan Problema Belajar*. Solo: PT Tiga Serangkai Pustaka Mandiri.